

-84-

## CLAIMS

1. A liquid droplet ejecting head ejecting liquid droplets by pressure waves caused by electrostatic forces, the liquid droplet ejecting head including: one or more nozzle holes ejecting the liquid droplets; one or more pressure liquid chambers communicating with the nozzle holes and containing liquid to be ejected; a common liquid chamber communicating with the pressure liquid chambers one or more diaphragms each forming a wall face of the corresponding pressure liquid chamber; one or more vibration chambers containing air gaps provided in contact with the diaphragms on an opposite side from the pressure liquid chambers; and one or more electrodes provided to oppose the diaphragms through the air gaps, the liquid droplets being ejected from the nozzle holes by increasing pressure inside the pressure liquid chambers by deflecting the diaphragms by the electrostatic forces generated by voltages applied to the electrodes, the liquid droplet ejecting head comprising:
- 20 a deformable plate whose deformation is greater than a total deformation of the diaphragms, the deformable plate forming a wall face of the common liquid chamber; and
- a pressure correcting chamber provided across said deformable plate from the common liquid chamber so as to
- 25 communicate with the vibration chambers.

-85-

2. The liquid droplet ejecting head as claimed in claim 1, wherein said deformable plate has a thickness less than that of each diaphragm.

5           3. The liquid droplet ejecting head as claimed in claim 1, wherein said deformable plate has an in-plane length greater than that of each diaphragm.

10           4. The liquid droplet ejecting head as claimed in claim 1, wherein a change in a total volume  $V_0$  of an actuator chamber is greater than or equal to  $0.15 \times V_0$  if a pressure of 53 hPa is applied evenly to said deformable plate, the change in the total volume  $V_0$  being caused by the deformation of said deformable plate.

15

5. The liquid droplet ejecting head as claimed in claim 1, wherein said pressure correcting chamber comprises a plurality of independent chambers corresponding to the vibration chambers.

20

6. An ink cartridge comprising:

a liquid droplet ejecting head ejecting ink droplets by pressure waves caused by electrostatic forces; and

an ink tank supplying ink to said liquid droplet head, the ink tank being integrated with said liquid droplet

25

-86-

ejecting head,

wherein the liquid droplet ejecting head includes:  
one or more nozzle holes ejecting the ink droplets; one or  
more pressure liquid chambers communicating with the nozzle  
5 holes and containing the ink to be ejected; a common liquid  
chamber communicating with the pressure liquid chambers; one  
or more diaphragms each forming a wall face of the  
corresponding pressure liquid chamber; one or more vibration  
chambers containing air gaps provided in contact with the  
10 diaphragms on an opposite side from the pressure liquid  
chambers; and one or more electrodes provided to oppose the  
diaphragms through the air gaps, the ink droplets being  
ejected from the nozzle holes by increasing pressure inside  
the pressure liquid chambers by deflecting the diaphragms by  
15 the electrostatic forces generated by voltages applied to the  
electrodes, the liquid droplet ejecting head comprising:

a deformable plate whose deformation is greater than  
a total deformation of the diaphragms, the deformable plate  
forming a wall face of the common liquid chamber; and  
20 a pressure correcting chamber provided across said  
deformable plate from the common liquid chamber so as to  
communicate with the vibration chambers.

7. An ink-jet recording apparatus comprising:  
25 an ink-jet head ejecting ink droplets by pressure

-87-

waves caused by electrostatic forces, the ink-jet head including: one or more nozzle holes ejecting the ink droplets; one or more pressure liquid chambers communicating with the nozzle holes and containing ink to be ejected; a common liquid chamber communicating with the pressure liquid chambers; one or more diaphragms each forming a wall face of the corresponding pressure liquid chamber; one or more vibration chambers containing air gaps provided in contact with the diaphragms on an opposite side from the pressure liquid chambers; and one or more electrodes provided to oppose the diaphragms through the air gaps, the ink droplets being ejected from the nozzle holes by increasing pressure inside the pressure liquid chambers by deflecting the diaphragms by the electrostatic forces generated by voltages applied to the electrodes, the ink-jet head comprising:

a deformable plate whose deformation is greater than a total deformation of the diaphragms, the deformable plate forming a wall face of the common liquid chamber; and

a pressure correcting chamber provided across said deformable plate from the common liquid chamber so as to communicate with the vibration chambers.

8. A micropump transporting liquid by deformation of one or more diaphragms, the micropump including: a channel in which the liquid is transported; the diaphragms forming a

-88-

wall face of the channel; one or more vibration chambers air gaps provided in contact with the diaphragms on an opposite side from the channel; and a plurality of electrodes provided to each of the diaphragms, the liquid being transported by  
5 increasing pressure inside the channel by deflecting the diaphragms by electrostatic forces generated by voltages applied to the electrodes, the micropump comprising:

a deformable plate whose deformation is greater than a total deformation of the diaphragms, the deformable plate  
10 forming the wall face of the channel; and

a pressure correcting chamber provided across said deformable plate from the channel so as to communicate with the vibration chambers.

15 9. An electrostatic actuator including: a vibration chamber having at least one side thereof formed by a diaphragm deformable by an electrostatic force; an electrode provided opposite the diaphragm; and a pressure correcting chamber communicating with the vibration chamber, the pressure  
20 correcting chamber having at least a first side thereof formed by a deformable part that is displaceable in accordance with an external pressure, the electrostatic actuator comprising:

a part that reduces an area of contact formed when the deformable part comes into contact with a second side of  
25 the pressure correcting chamber, the second side opposing the

-89-

deformable part.

10. The electrostatic actuator as claimed in claim  
9, wherein at least one projection is formed on a side of the  
5 deformable part which side opposes the second side of the  
pressure correcting chamber.

11. The electrostatic actuator as claimed in claim  
10, wherein the projection is formed of a material selected  
10 from a group of silicon oxide and nitride oxide.

12. The electrostatic actuator as claimed in claim  
9, wherein at least one projection is formed on the second  
side of the pressure correcting chamber.

15

13. The electrostatic actuator as claimed in claim  
12, wherein the projection is formed of a material selected  
from a group of silicon oxide and nitride oxide.

20

14. The electrostatic actuator as claimed in claim  
9, wherein surface roughening is performed on the second side  
of the pressure correcting chamber so that surface roughness  
thereof is increased.

25

15. An electrostatic actuator including: a

-90-

vibration chamber having at least one side thereof formed by a diaphragm deformable by an electrostatic force; an electrode provided opposite the diaphragm; and a pressure correcting chamber communicating with the vibration chamber, the pressure  
5 correcting chamber having at least a first side thereof formed by a deformable part that is displaceable in accordance with an external pressure, the electrostatic actuator comprising:

a sticking preventing part formed on a second side of the pressure correcting chamber so as to prevent the  
10 deformable part from sticking to the second side when the deformable part comes into contact therewith, the second side opposing the deformable part.

16. The electrostatic actuator as claimed in claim  
15 15, wherein the sticking preventing part is a hydrophobic film.

17. The electrostatic actuator as claimed in claim  
15, wherein the sticking preventing part is a conductive layer.

20 18. A liquid droplet ejecting head comprising:  
a nozzle ejecting a liquid droplet;  
a pressure liquid chamber containing liquid to be ejected, the pressure liquid chamber communicating with said nozzle; and

25 an electrostatic actuator pressurizing the liquid in

-91-

said pressure liquid chamber, the electrostatic actuator including: a vibration chamber having at least one side thereof formed by a diaphragm deformable by an electrostatic force; an electrode provided opposite the diaphragm; and a  
5 pressure correcting chamber communicating with the vibration chamber, the pressure correcting chamber having at least a first side thereof formed by a deformable part that is displaceable in accordance with an external pressure,

the electrostatic actuator comprising:

10 a part that reduces an area of contact formed when the deformable part comes into contact with a second side of the pressure correcting chamber, the second side opposing the deformable part.

15 19. A liquid droplet ejecting head comprising:

a nozzle ejecting a liquid droplet;

a pressure liquid chamber containing liquid to be ejected, the pressure liquid chamber communicating with said nozzle; and

20 an electrostatic actuator pressurizing the liquid in said pressure liquid chamber, the electrostatic actuator including: a vibration chamber having at least one side thereof formed by a diaphragm deformable by an electrostatic force; an electrode provided opposite the diaphragm; and a  
25 pressure correcting chamber communicating with the vibration



-92-

chamber, the pressure correcting chamber having at least a first side thereof formed by a deformable part that is displaceable in accordance with an external pressure,

the electrostatic actuator comprising:

5                   a sticking preventing part formed on a second side of the pressure correcting chamber so as to prevent the deformable part from sticking to the second side when the deformable part comes into contact therewith, the second side opposing the deformable part.

10

20. An ink-jet recording apparatus comprising:

an ink-jet head ejecting an ink droplet,

the ink-jet head comprising:

a nozzle ejecting the ink droplet;

15                   a pressure liquid chamber containing ink to be ejected, the pressure liquid chamber communicating with said nozzle; and

an electrostatic actuator pressurizing the ink in said pressure liquid chamber, the electrostatic actuator including: a vibration chamber having at least one side thereof formed by a diaphragm deformable by an electrostatic force; an electrode provided opposite the diaphragm; and a pressure correcting chamber communicating with the vibration chamber, the pressure correcting chamber having at least a first side thereof formed by a deformable part that is

20

25

-93-

displaceable in accordance with an external pressure,

the electrostatic actuator comprising:

a part that reduces an area of contact  
formed when the deformable part comes into contact with a  
5 second side of the pressure correcting chamber, the second  
side opposing the deformable part.

21. An ink-jet recording apparatus comprising:

an ink-jet head ejecting an ink droplet,

10 the ink-jet head comprising:

a nozzle ejecting the ink droplet;

a pressure liquid chamber containing ink to be  
ejected, the pressure liquid chamber communicating with said  
nozzle; and

15 an electrostatic actuator pressurizing the ink  
in said pressure liquid chamber, the electrostatic actuator  
including: a vibration chamber having at least one side  
thereof formed by a diaphragm deformable by an electrostatic  
force; an electrode provided opposite the diaphragm; and a  
20 pressure correcting chamber communicating with the vibration  
chamber, the pressure correcting chamber having at least a  
first side thereof formed by a deformable part that is  
displaceable in accordance with an external pressure,

the electrostatic actuator comprising:

25 a sticking preventing part formed on a

-94-

second side of the pressure correcting chamber so as to prevent the deformable part from sticking to the second side when the deformable part comes into contact therewith, the second side opposing the deformable part.

5

22. A liquid supply cartridge integrating a liquid droplet ejecting head and a liquid supply tank supplying liquid thereto, wherein:

the liquid droplet ejecting head comprises:

10

a nozzle ejecting a liquid droplet;

a pressure liquid chamber containing the liquid to be ejected, the pressure liquid chamber communicating with said nozzle; and

15

an electrostatic actuator pressurizing the liquid in said pressure liquid chamber, the electrostatic actuator including: a vibration chamber having at least one side thereof formed by a diaphragm deformable by an electrostatic force; an electrode provided opposite the diaphragm; and a pressure correcting chamber communicating with the vibration chamber, the pressure correcting chamber having at least a first side thereof formed by a deformable part that is displaceable in accordance with an external pressure,

20

the electrostatic actuator comprising:

25

a part that reduces an area of contact

-95-

formed when the deformable part comes into contact with a second side of the pressure correcting chamber, the second side opposing the deformable part.

5           23. A liquid supply cartridge integrating a liquid droplet ejecting head and a liquid supply tank supplying liquid thereto, wherein:

the liquid droplet ejecting head comprises:

a nozzle ejecting a liquid droplet;

10           a pressure liquid chamber containing the liquid to be ejected, the pressure liquid chamber communicating with said nozzle; and

an electrostatic actuator pressurizing the liquid in said pressure liquid chamber, the electrostatic actuator including: a vibration chamber having at least one side thereof formed by a diaphragm deformable by an electrostatic force; an electrode provided opposite the diaphragm; and a pressure correcting chamber communicating with the vibration chamber, the pressure correcting chamber having at least a first side thereof formed by a deformable part that is displaceable in accordance with an external pressure,

the electrostatic actuator comprising:

25           a sticking preventing part formed on a second side of the pressure correcting chamber so as to

-96-

prevent the deformable part from sticking to the second side when the deformable part comes into contact therewith, the second side opposing the deformable part.